

## CO2 Washout Capability with Breathing Manikin

Completed Technology Project (2013 - 2013)

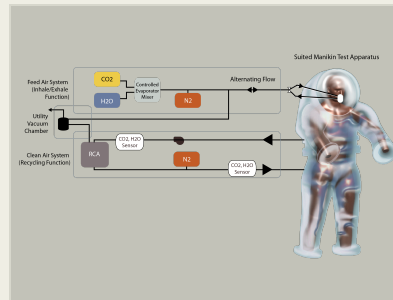


## Project Introduction

Carbon Dioxide (CO<sub>2</sub>) Washout performance is a critical parameter needed to ensure proper and sufficient designs in a spacesuit and in vehicle applications such as sleep stations and hygiene compartments. Human testing to fully evaluate CO<sub>2</sub> washout is expensive due to the levied safety requirements. Moreover, correlation of math models becomes challenging because of human variability and movement. A breathing capability will be integrated into a Suited Manikin Test Apparatus (SMTA) to provide a safe, lower cost, stable, easily modeled alternative to human CO<sub>2</sub> washout testing. Lastly, this configuration provides JSC the capability to evaluate carbon dioxide washout under off-nominal conditions that would otherwise be unsafe for human testing or difficult due to fatigue of a test subject.

The intent of this particular project was to perform the following: Provide a breathing capability to be integrated into existing EC5 Ventilation Lab Suited Manikin Test Apparatus (SMTA). Evaluate flow controllers and ancillary equipment needed to provide breathing function including proper CO<sub>2</sub> and humidity levels varying appropriately with simulated metabolic rate profiles. The SMTA will be upgraded to include the fully capable breathing apparatus components that will be sufficient to simulate human breathing providing the capability to rapidly explore the range of human metabolic activity expected during Extravehicular Activity (EVA). Testing performed with the SMTA will benefit development efforts including Advanced Exploration Systems (AES) Advanced Extravehicular Mobility Unit (AEMU) Helmet and Portable Life Support System (PLSS) development and Space Technology Mission Directorate Rapid Cycling Amine development. Future upgrades to the SMTA could include the capability to include various helmet designs, human head geometries and positions, and ventilation inlet configurations. Moreover, the test apparatus will be directly applicable to validating future suit air revitalization hardware and flow components as new technologies become available.

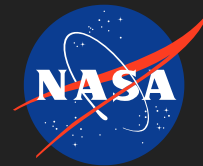
## Anticipated Benefits



Project Image CO<sub>2</sub> Washout Capability with Breathing Manikin

## Table of Contents

Project Introduction	1
Anticipated Benefits	1
Primary U.S. Work Locations and Key Partners	2
Organizational Responsibility	2
Project Management	2
Images	3
Technology Maturity (TRL)	3
Technology Areas	3

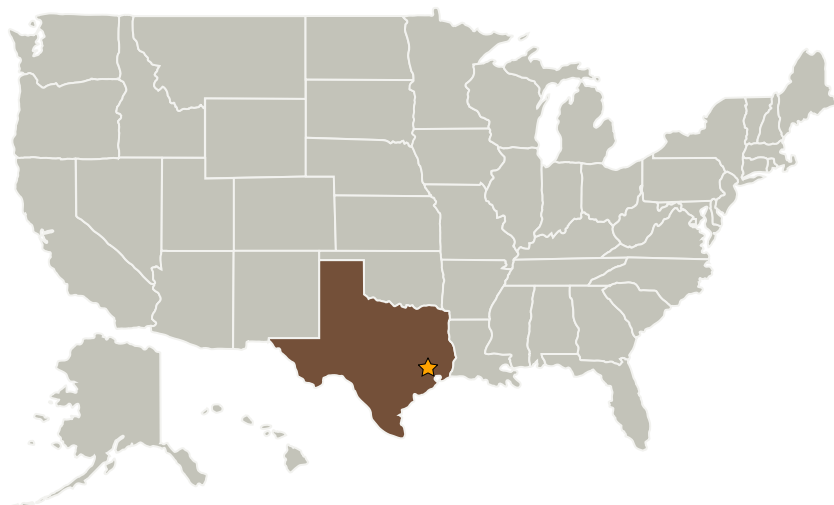


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- Efficient methods for CO2 capture are highlighted as a benefit.
- The SMTA breathing capability supports the Advanced Exploration Systems (AES) Advanced Extravehicular Mobility Unit (AEMU) Portable Life Support System (PLSS) project, the Office of the Space Technology Mission Directorate (STMD) Rapid Cycling Amine (RCA) development, the Advanced spacesuit project and also can be used to support vehicle breathing assessments in a cabin environment.
- Evaluation of CO2 washout is potentially important to other applications such as breathing equipment supporting miners, firefighters and other confined space operations (currently assessed by National Institute for Occupational Safety and Health (NIOSH) and others).

## Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Johnson Space Center(JSC)	Lead Organization	NASA Center	Houston, Texas

## Primary U.S. Work Locations

Texas

## Organizational Responsibility

### Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

### Lead Center / Facility:

Johnson Space Center (JSC)

### Responsible Program:

Center Innovation Fund: JSC CIF

## Project Management

### Program Director:

Michael R Lapointe

### Program Manager:

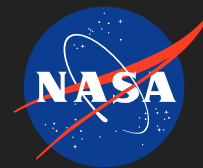
Carlos H Westhelle

### Project Manager:

Cinda Chullen

### Principal Investigator:

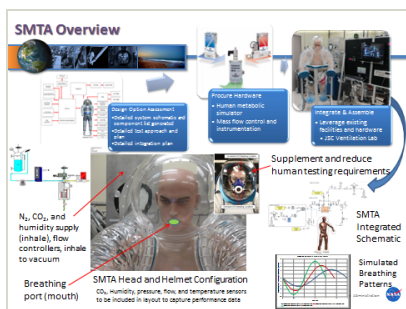
Cinda Chullen

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Project Image CO2 Washout  
Capability with Breathing Manikin  
(<https://techport.nasa.gov/image/2281>)

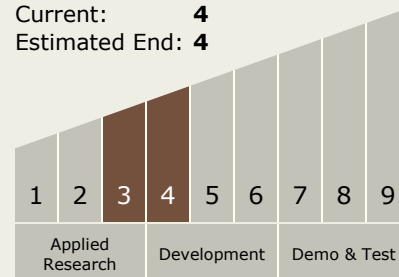


Project Image CO2 Washout  
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(<https://techport.nasa.gov/image/2292>)



Project Image CO2 Washout  
Capability with Breathing Manikin  
(<https://techport.nasa.gov/image/2300>)

Start: **3**  
Current: **4**  
Estimated End: **4**



## Technology Areas

**Primary:**

- TX06 Human Health, Life Support, and Habitation Systems
  - └ TX06.1 Environmental Control & Life Support Systems (ECLSS) and Habitation Systems
    - └ TX06.1.1 Atmosphere Revitalization